



## Emotion dysregulation, anticipatory cortisol, and substance use in urban adolescents



Wendy Kliewer<sup>\*</sup>, Tennisha Riley, Nikola Zaharakis, Alicia Borre, Tess K. Drazdowski, Lena Jäggi

Department of Psychology, Virginia Commonwealth University, United States

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### ABSTRACT

Anticipatory cortisol is associated with risk for substance use in adolescents. The present study extended prior literature by testing a model linking family emotional climate, emotion dysregulation, anticipatory cortisol, and substance use. Participants were 229 adolescents ( $M = 11.94$  years,  $SD = 1.55$ ; 41% male; 92% African American) enrolled in a 4-wave study of stressors, physiological stress responses, and substance use. Caregivers completed measures of family emotional climate at baseline and adolescents' emotion dysregulation one and two years later; adolescents reported on their substance use at baseline and three years later at Wave 4. Adolescents completed a stress task at Wave 4; saliva samples taken immediately prior to the task were analyzed for cortisol. Longitudinal path models revealed that a negative emotional climate at home was associated with elevated emotion dysregulation at subsequent waves for all youth. Emotional dysregulation was prospectively associated with blunted anticipatory cortisol, which in turn was associated with elevated substance use, controlling for baseline substance use and age. However, these associations only were observed for females. This study suggests that helping girls in particular manage their emotional responses to stress more effectively may impact their physiological responses and reduce risk for substance use.

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### 1. Introduction

Rates of adolescent substance use, though on the decline overall, remain high (CDC, 2014). Although a substantial amount of research has focused on understanding the developmental precursors of substance use and other risky behaviors (Scheier, 2010), there is relatively less information regarding physiological correlates of substance use in adolescents.

Researchers have linked physiological stress responses such as heart rate, skin conductance, and cortisol reactivity with externalizing behavior in adolescents (Evans et al., 2012; Moss, Vanyukov, Yao, & Kirillova, 1999). In one of the few studies examining physiological stress response and adolescent substance use, Evans et al. (2012) found that adolescents who reported regularly consuming moderate to high amounts of alcohol displayed lower heart rates during a stress task than those who reported consuming lower amounts; this finding was replicated with tobacco use. These studies confirm the hypo-arousal theory of risk behavior in adolescence, which suggests a low threshold for physiological arousal is related to engaging in more risky behaviors. Individuals with blunted physiological responses to stress or emotional stimuli may seek out more risk-

taking behaviors in order to increase or regulate arousal levels, or because they simply lack fear or anxiety and a lack of concern for negative consequences (see van Goozen, Fairchild, Snoek, & Harold, 2007).

A developmental perspective on physiological hypo-arousal suggests that early exposure to adversity in childhood influences later physiological stress responses through repeated exposure or accumulated risk (Evans & Kim, 2007; Lovallo, 2013). In particular, environmental risk factors such as parental substance use (Evans, Greaves-Lord, Euser, Franken, & Huizink, 2013; Evans et al., 2012; Moss et al., 1999), childhood physical abuse (Carpenter, Shattuck, Tyrka, Geraciotti, & Price, 2011), and repeated exposure to violence (Aiyer, Heinze, Miller, Stoddard, & Zimmerman, 2014) are associated with blunted cortisol. Youth exposed to these environmental stressors may experience them chronically through a negative emotional climate that develops in the home and that is reflected in interactions characterized by irritation, anger, conflict, criticism, disrespect, blame, or threats.

The relation between experiencing stressors and blunted cortisol reactivity may, in part, be explained by difficulty with regulating emotions. Indeed individuals diagnosed with post-traumatic stress disorder have higher levels of emotion dysregulation (Tull, Barrett, McMillan, & Roemer, 2007). It is likely that youth who have ongoing exposure to a negative family emotional climate are at an increased risk for emotion dysregulation, which also may lead to substance use as a way of coping with the negative affect associated with these stressors.

Further, the regulation of emotional responses, along with other individual differences reflecting underlying temperament, may be linked

<sup>\*</sup> Corresponding author at: Department of Psychology, Virginia Commonwealth University, PO Box 842018, Richmond, VA 23284-2018, United States.

E-mail addresses: [wkliwer@vcu.edu](mailto:wkliwer@vcu.edu) (W. Kliewer), [rileytn2@mymail.vcu.edu](mailto:rileytn2@mymail.vcu.edu) (T. Riley), [nikola.zaharakis@vcuhealth.org](mailto:nikola.zaharakis@vcuhealth.org) (N. Zaharakis), [borremontej@vcu.edu](mailto:borremontej@vcu.edu) (A. Borre), [drazdowskitk@vcu.edu](mailto:drazdowskitk@vcu.edu) (T.K. Drazdowski), [jaggil@vcu.edu](mailto:jaggil@vcu.edu) (L. Jäggi).

to cortisol responses (Ayer et al., 2013; Shoal, Giancola, & Kirillova, 2003). Ayer et al. (2013) found that preadolescents from a Dutch longitudinal population study with a persistent dysregulated profile showed blunted levels of cortisol in response to stress. The results of the Ayer et al. (2013) study coupled with hypo-arousal theory provides evidence that individual differences in emotion dysregulation are influenced by contextual stressors and may affect HPA axis activation in several ways. First, youth with dysregulated emotional responses may experience a greater number of stressors as a consequence of their emotional reactivity. A transactional approach to development notes that children not only react to their environment, but actively contribute to it (Sroufe & Rutter, 1984). This stress exposure may contribute to a repeated cycle of HPA axis activation, and over time may alter or blunt the typical HPA axis response to threat (Tsigos & Chrousos, 2002). Second, youth with dysregulated emotional responses may have an underlying sensitivity to the stressors they encounter, which also may alter the typical HPA axis response. However, more longitudinal research needs to be conducted in this area among diverse populations of youth. Research on HPA axis activation and externalizing behaviors during adolescence is equivocal. Most previous research on correlates of HPA axis activation has used baseline-resting measures or reactivity responses (c.f., Van de Wiel, Van Goozen, Matthys, Snoek, & Van Engeland, 2004). The activation of the HPA axis is contingent on either exposure to stress or the mere threat of stress (Stroud et al., 2009). Examining cortisol secretions in anticipation of a stressor may provide a more accurate measure of the body's stress response, and provides a unique perspective of contexts in which the threat of stress is frequently present, and the potential for continuous over-activation of the HPA. Recent research measuring cortisol in anticipation of a stressful event has shown significant associations with later substance use (Evans et al., 2012, 2013; Moss et al., 1999).

The primary purpose of the present study was to test a model linking negative family emotional climate, emotional dysregulation, blunted anticipatory cortisol, and substance use in adolescents. A second exploratory purpose of the study was to determine if the model differed by sex. Based on prior literature we proposed that a negative family emotional climate would contribute to emotional dysregulation in youth. Emotional dysregulation, in turn, would be associated with blunted anticipatory cortisol, which would be associated with elevated substance use.

## 2. Method

### 2.1. Participants

Participants included 229 urban adolescents ( $M = 11.95$  years,  $SD = 1.55$ ; 42% male; 92% African American) and their maternal caregivers participating in a 4-wave longitudinal study of stressors, physiological stress responses, and substance use. Just over half of the sample (54%) had household incomes below the poverty line based on Federal guidelines, and median caregiver education was completion of high school. A range of family structures was represented in the sample, although many (41%) of the caregivers had never married.

### 2.2. Procedure

The Institutional Review Board at Virginia Commonwealth University approved the project. Participants were recruited from neighborhoods in and around Richmond, VA, with high levels of violence and/or poverty based on police statistics and census data. Participants were recruited through community agencies and events, and by canvassing qualifying neighborhoods via flyers posted door-to-door. To be eligible, participants had to have a fifth or eighth grader living in the home, and a female caregiver needed to participate in the interview. Only English-speaking participants were recruited into the study. Participants were not screened for substance use as a criterion for participation. Eligible respondents were scheduled for interviews, which

were conducted in participants' homes unless a family requested to be interviewed elsewhere. Sixty-three percent of eligible participants agreed to be in the study, which is consistent with studies using similar designs and populations.

Interviewers thoroughly reviewed the parental consent and adolescent assent forms with the family. Assent was provided by the adolescent before initiating the adolescent interview. Participants agreed to participate in a series of four annual interviews. A Certificate of Confidentiality was obtained from the National Institutes of Health (NIH) to protect families' responses since adolescents were reporting on illegal behavior (i.e., substance use) as part of the study. Face-to-face interviews using visual aids were used to collect the data, and all questions were read aloud, with the exception of a small portion of the adolescent interview. Adolescents who had passed a reading-screening test answered several (primarily sensitive) questions in a booklet without interviewer assistance. Tests for interviewer race and sex effects revealed no systematic biases,  $ps > 0.10$ . Interviews with the caregiver and adolescent lasted approximately 2.5 h and participants received \$50 in gift cards per family at each wave.

### 2.3. Measures

#### 2.3.1. Family emotional climate

The 10-item negative dominant subscale of the *Family Expressiveness Questionnaire* (FEQ; Halberstadt, 1986), reported by parents at Wave 1, was used to assess family emotional climate. Items represent a range of negative emotions typical of many families and are rated on a 9-point scale ranging from (1) *not at all frequently in my family* to (9) *very frequently in my family*. Participants were instructed to complete the measure with respect to the family with whom they currently lived, including themselves, their spouses/partners (if applicable), children, and other individuals living in the household. Halberstadt (1986) reports excellent reliability and validity for the measure. This subscale was concurrently correlated with family stressors and maternal adjustment problems ( $r_s = 0.32$ – $0.39$ ), also evidencing its validity. In the current study, Cronbach alpha was 0.80. Higher scores reflect a more negative emotional climate.

#### 2.3.2. Emotion dysregulation

Parent-reported emotional lability and frustration tolerance, assessed at Waves 2 and 3, were used to index a latent construct of emotion dysregulation. Lability was assessed with the 16-item lability subscale from the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997). Each item on the ERC is rated on a four-point Likert scale from (1) *never* to (4) *always*. The lability subscale consists of items tapping lack of flexibility, mood lability, and anger dysregulation, such as "Exhibits wide mood swings." The ERC has excellent reliability and validity. Cronbach alphas in the present study were 0.86 for Wave 2 and 0.84 for Wave 3. The 5-item frustration tolerance subscale of the Teacher-Child Rating Scale – Parent Version (TCRS-P; Wyman et al., 1999) was used to measure frustration. Each item on the TCRS subscale is rated on a 5-point scale ranging from (1) *not at all well* to (4) *very well*. The frustration tolerance subscale includes items such as "accepts things not going his/her way." The TCRS has excellent validity and reliability. Scale scores were recoded that higher scores reflected worse frustration tolerance. Cronbach alpha in the present study was 0.83 at both Waves 2 and 3.

#### 2.3.3. Substance use

Three measures of adolescent substance use at Wave 4 were used as manifest indicators of a latent construct of substance use. These included: (1) the 6-item drug use subscale of the Problem Behavior Frequency Scales (PBFS; Farrell, Kung, White, & Valois, 2000), which assessed past month substance use. Adolescents indicated how frequently they engaged in the behavior over the past 30 days using a six-point scale: never, 1–2 times, 3–5 times, 6–9 times, 10–19 times, and 20 times or

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